Evaluating and Enhancing the Performance of Reefs Built with Military Armored Vehicles

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Military Armored Vehicles (MAVs)

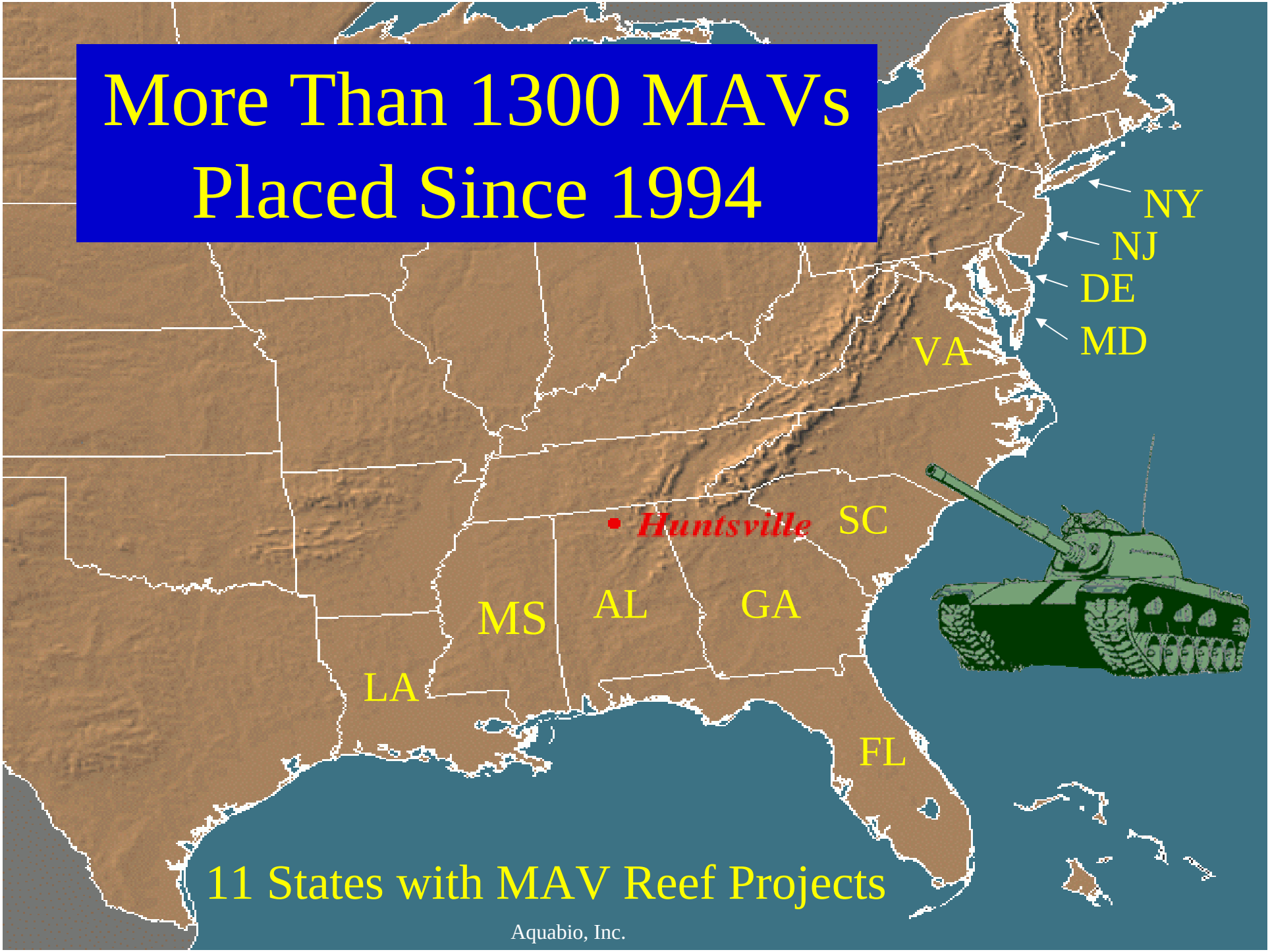
M-60

M-551

M-113

M-901

More Than 1300 MAVs Placed Since 1994



Environmental Preparation

Engine removal & cleaning

Placing MAVs on Reef Sites

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Monitoring

Diver visual inspection and fish counts

Video recording fish feeding behavior

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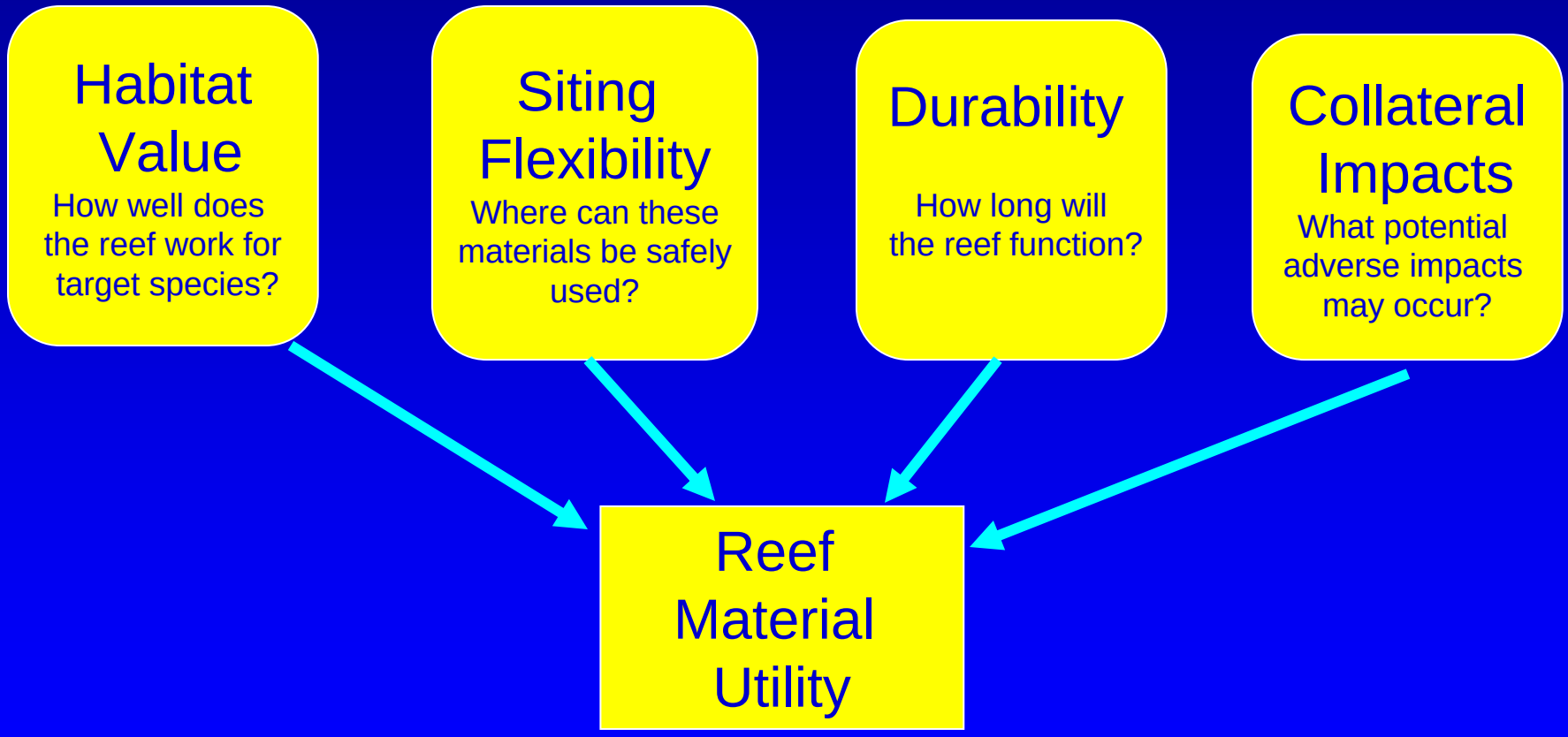
Framework for Evaluating Materials for Reef Construction



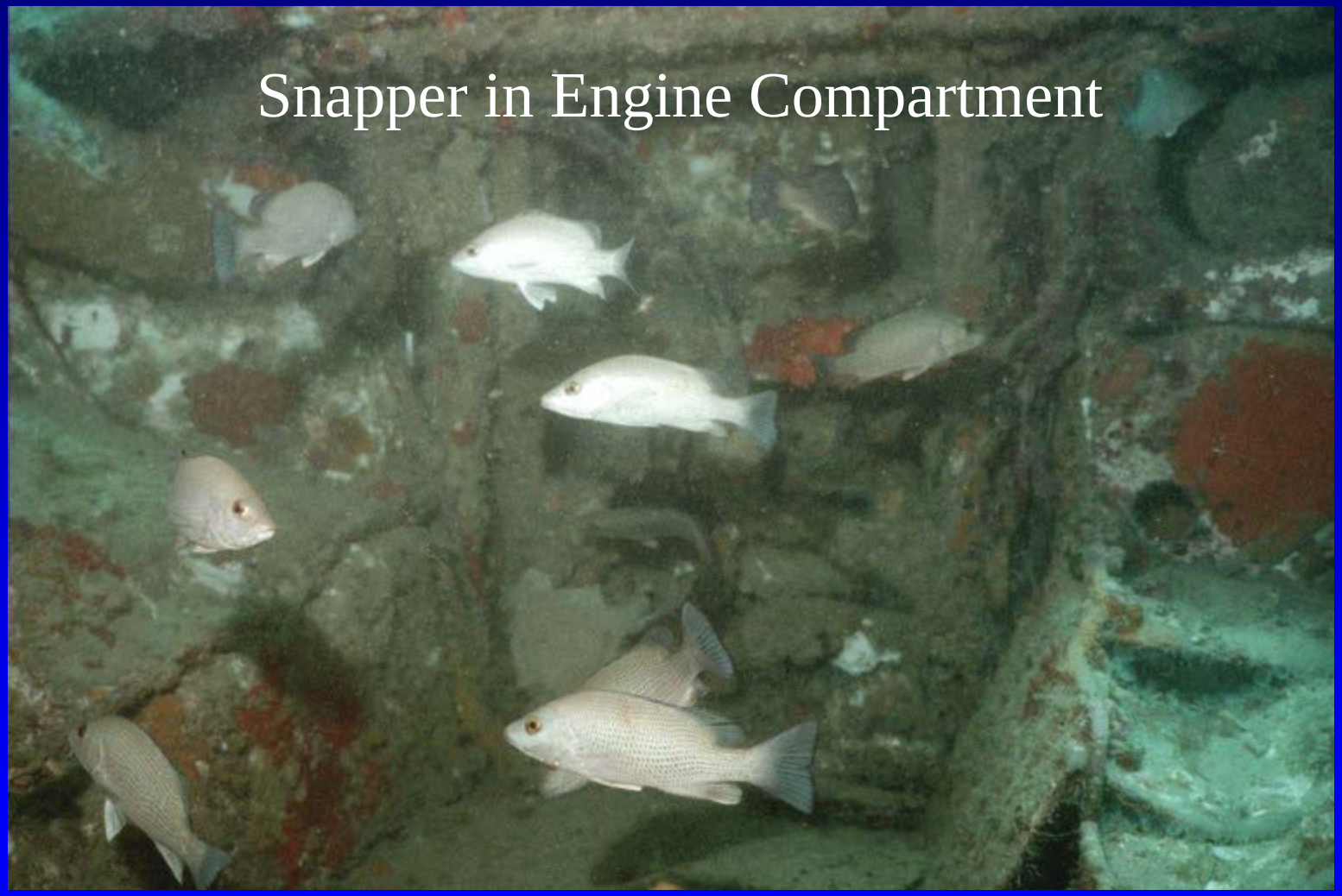
Habitat Value

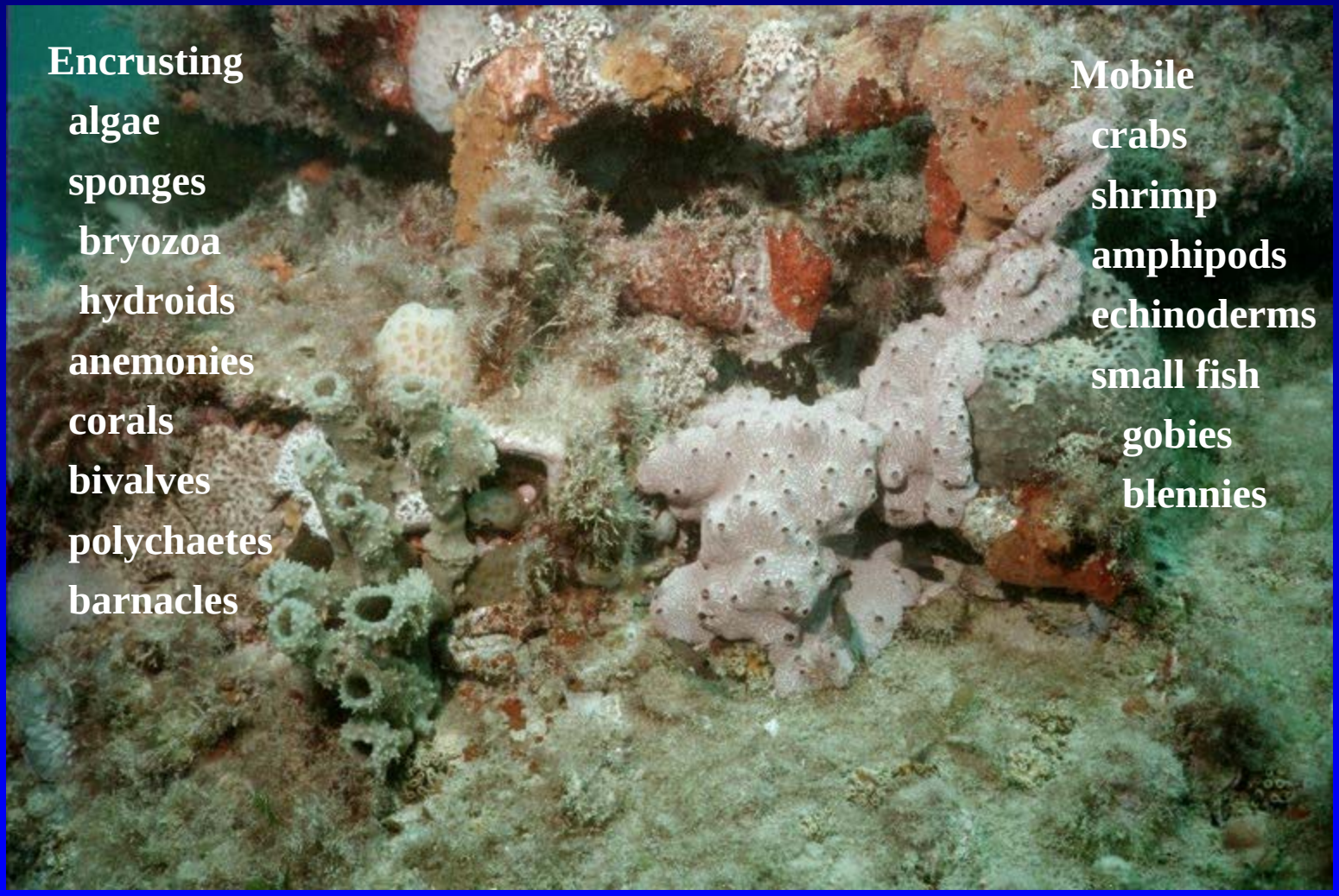
- **Fish -** excellent for reef-associated species
  - Bottom fish- very effective for target grouper-snapper complex due to large internal voids
  - Midwater fish- less effective, due to low profile
- **Epibenthos -**very effective due to stable and complex microtopography that multiplies surface area and the variety of niches available
- **Plankton -** limited concentration, but evidence of benthic production

Goliath Grouper Under M-60 Tank


Grouper Under Tank Hull

Snapper in Engine Compartment




Encrusting
algae
sponges
bryozoa
hydroids
anemonies
corals
bivalves
polychaetes
barnacles
Mobile
crabs
shrimp
amphipods
echinoderms
small fish
gobies
blennies

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Main Gun Barrel of M-60

Turret of a Shallow M-60 Tank

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Sheepshead eating barnacles off open hatch

Triggerfish eating crustaceans on tank deck

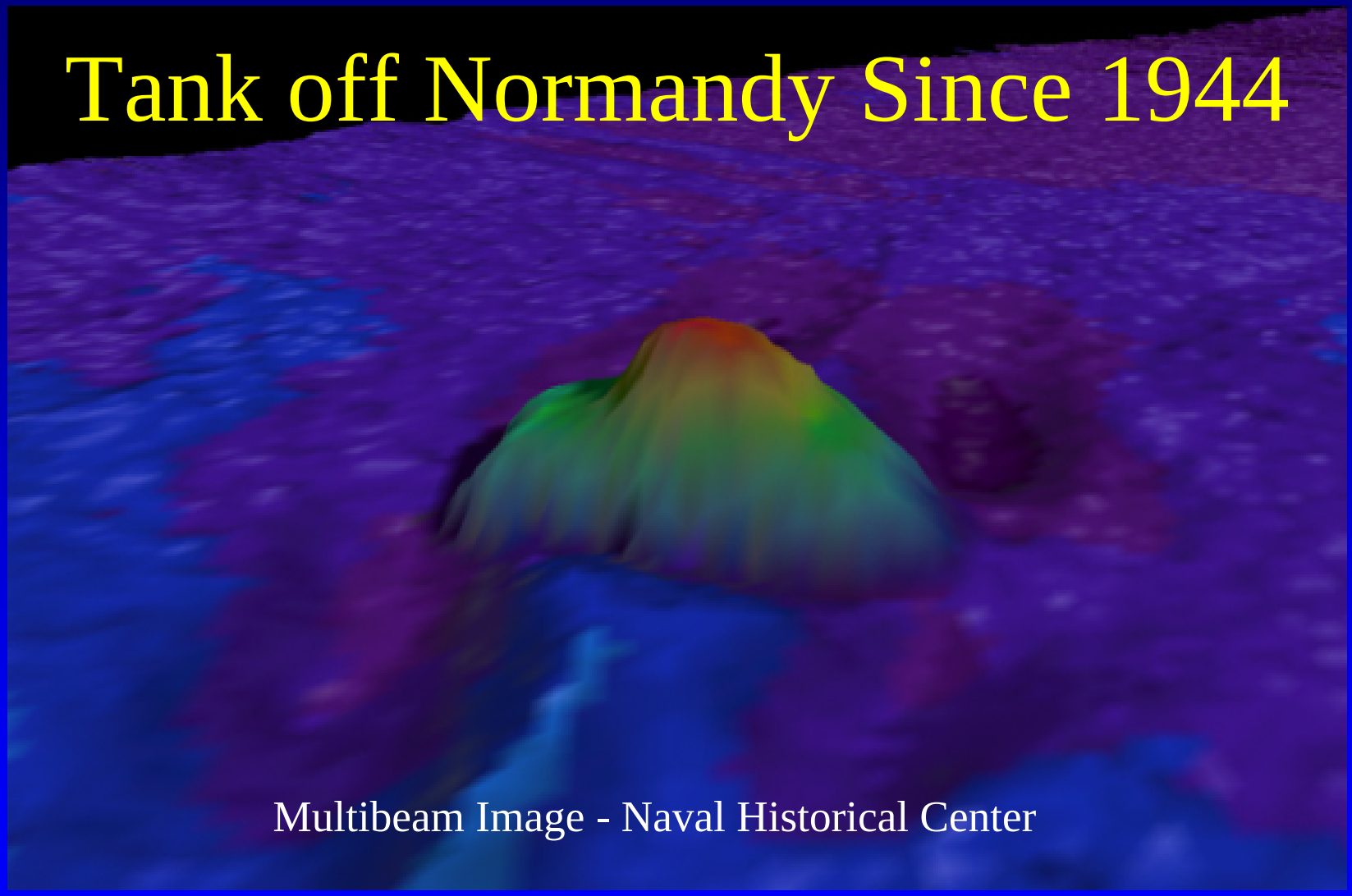
Siting Flexibility

- Excellent bottom stability due to unit mass & density and broad track surface area
- Well suited for high-energy (often near-shore) sites that are unsuitable for many other types of reef materials
- Deeper sites had some orientation problems
- Subsidence was a problem at some sites

Durability

- Predict at least 100 year effective life (M-60)
- Structural integrity
  - Heavy gauge metal resists corrosion
  - Unit integrity reduces deterioration
- Physical stability on the bottom
  - High density resists movement
  - Shape limits drag and lift
  - Wide track/hull surface area resists subsidence

Tank off Normandy Since 1944



Multibeam Image - Naval Historical Center

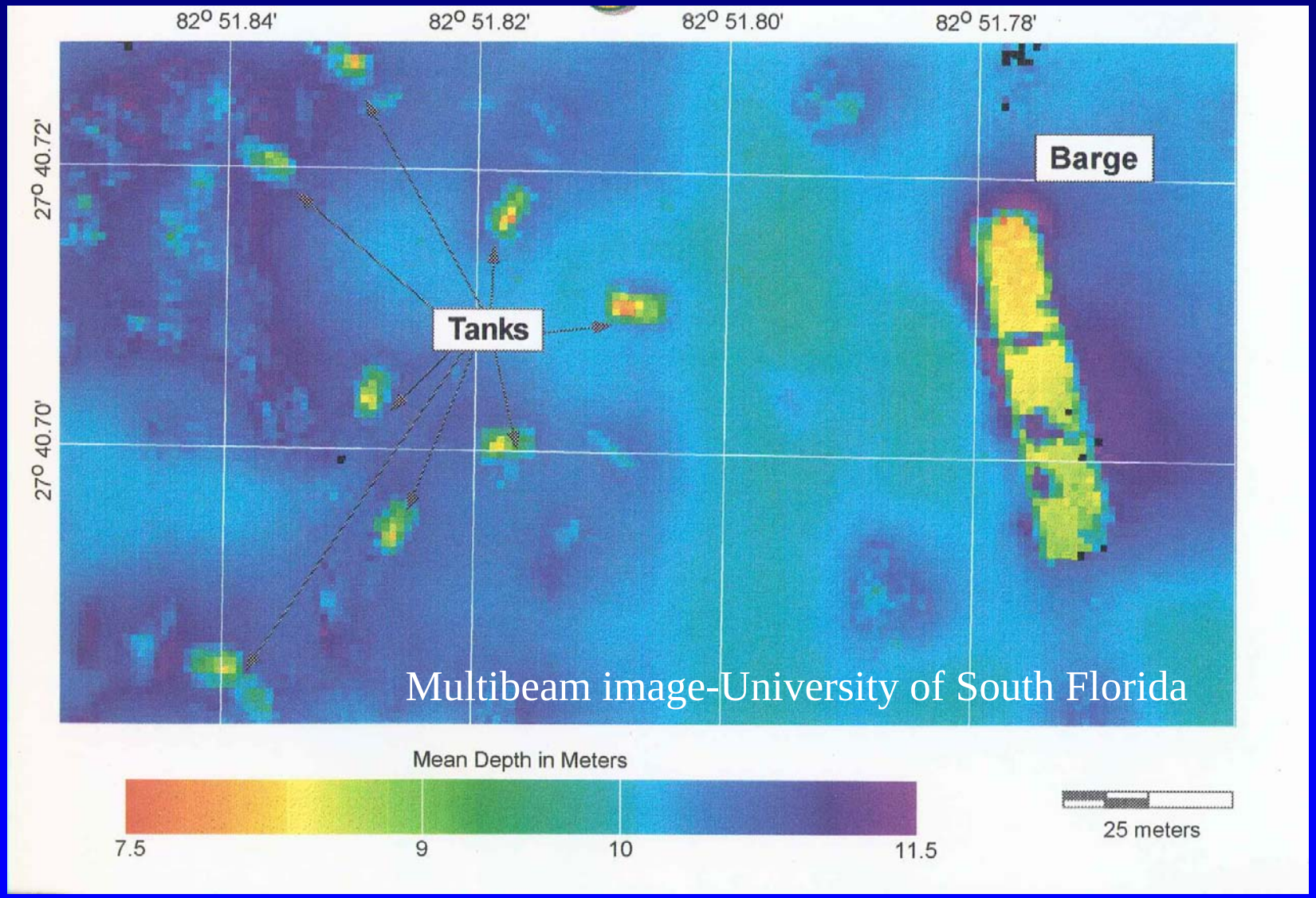
Collateral Damage

- Environmental
  - Preparation reduced pollution sources
  - Bottom stability minimized habitat damage
  - Unit integrity minimized stuctural deterioration
- Fishing
  - Few snags reduced angling gear loss
  - Stability and integrity reduced net gear loss
- Diving- limited potential entrapment problems

Recommendations

- Improve MAV placement to control:
  - Inter-unit spacing
  - Upright orientation
  - Reef configuration
- Confirm and publish accurate GPS locations
- Reduce potential for diver penetration
- Refine site selection

Reef Unit Spacing



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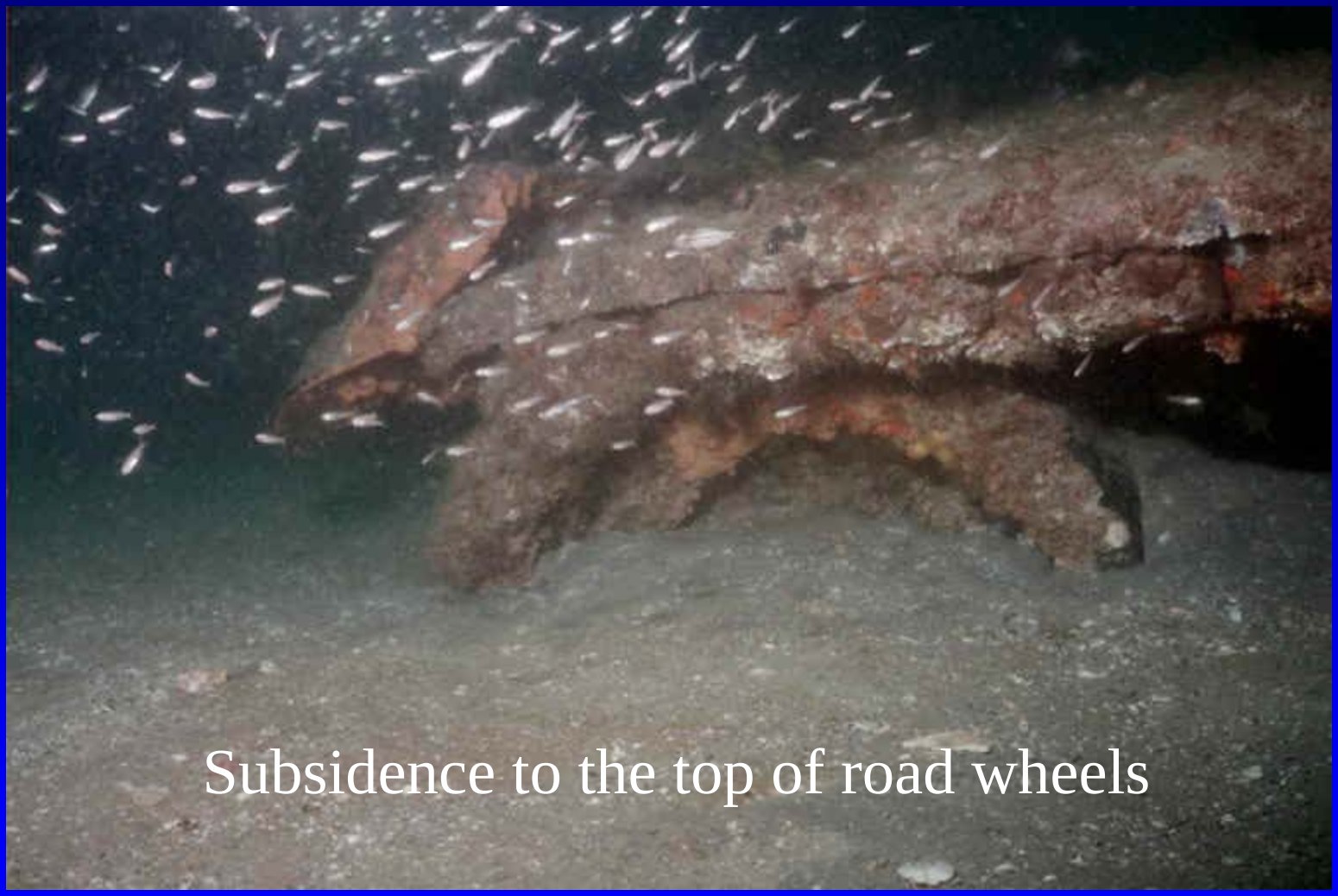
M-60 Upside down



Subsidence to the top of road wheels

Fish Aggregation Device (FAD) Enhancement Study

- FADs attached to MAVs at several sites
- Examined fish abundance and diversity on MAVs, MAVFADs, and bare bottom sites
- Studied behavior-ecology of target and forage fish
- Examined the development of epibenthic community on FADs

Fish Aggregation Devices

FAD under construction

- Prototype net FAD
  - temporary
  - inexpensive
- Attached to lift eyes on 4 corners of MAV
- Can be installed on surface (before placement) or by divers

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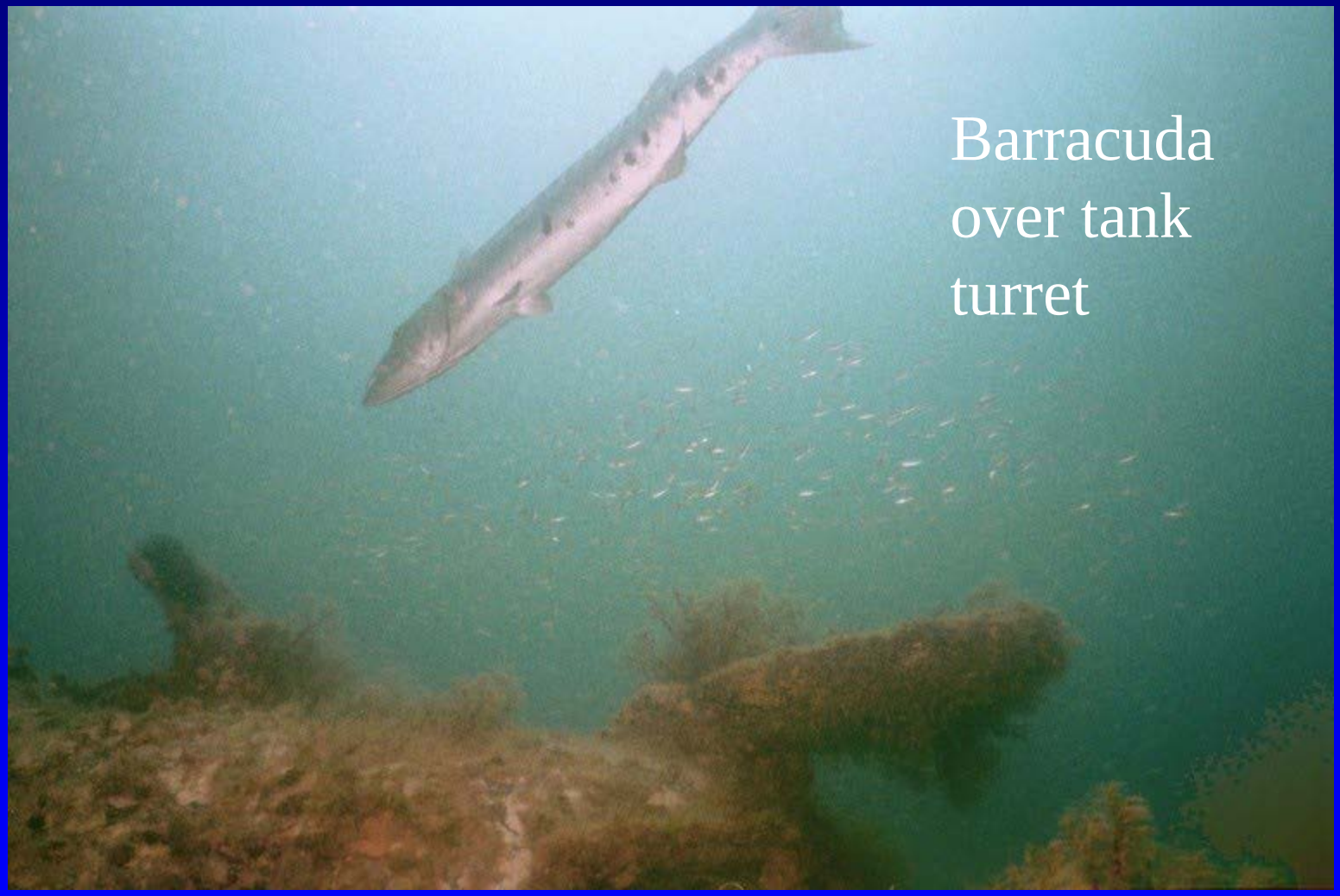
Bait fish surround net FAD attached to tank

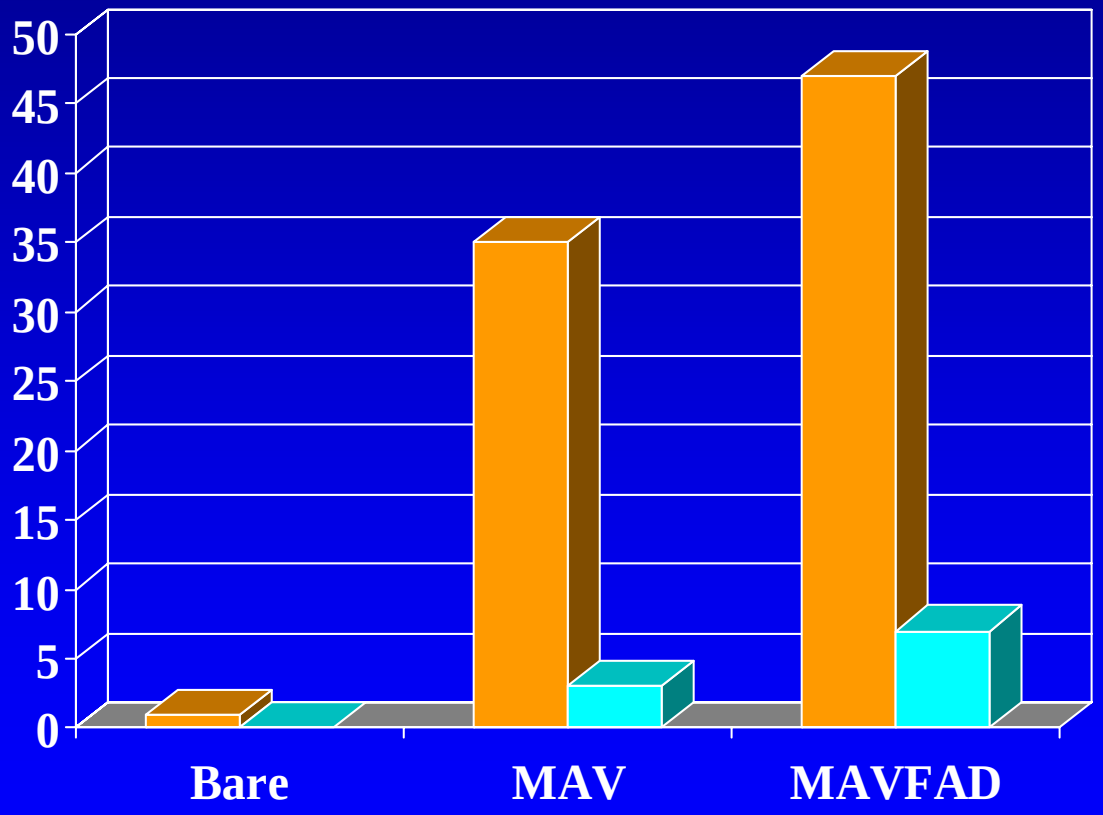

Barracuda
over tank
turret

Blue Runner around recently attached FADs

Net community

- **bryozoa**
- **colonial tunicates**
- **small bivavlves**
- **barnacles**
- **amphipods**

Fish Abundance by Site Type



Common bottom fish

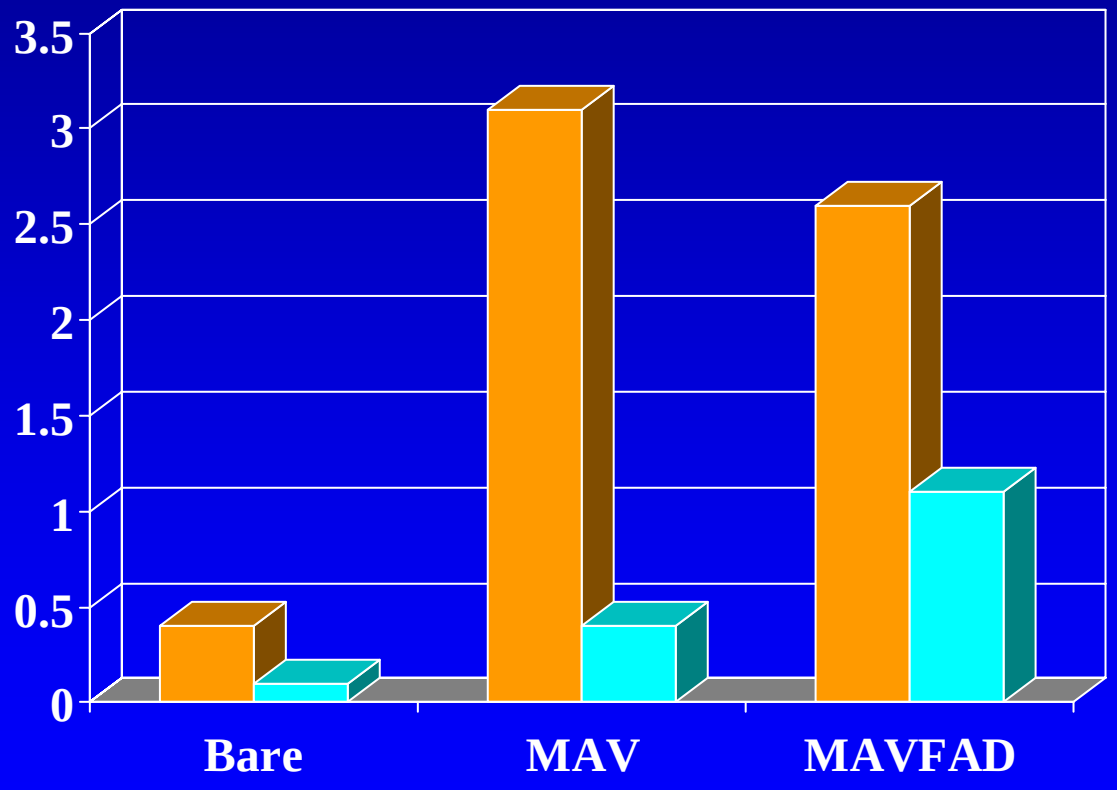
- snapper 2
- grouper 2
- spadefish
- sheepshead

Bottom Fish
Midwater Fish

Common midwater fish

- amberjack
- barracuda
- blue runner
- Spanish mackerel

Species Diversity by Site Type



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Current Investigations

- Studies to improve understanding of the
  - Linkage between forage base and predators
  - Mechanisms contributing to reef perfomance
- New types of reef applications
- Other potential DoD obsolete items
- Planned demonstration incorporating initial recommendations for MAV placement

Reef Food Resources

Airlift sampler

Net section removal

Summary

- Reefs built from appropriate obsolete DoD materials can provide effective fish habitat
- Better placement control and siting can improve reef performance and utilization
- Midwater attractors can, where appropriate, enhance reef performance
- Reefs can also provide effective tools for mitigation, restoration and conservation

Acknowledgements

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“Tanks for the habitat” ....